

TOURNIQUET

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CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of the filing of U.S. Provisional Patent Application Serial No. 60/255,973, entitled "Tourniquet", filed on December 14, 2000, and the specification thereof is incorporated herein by reference.

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BACKGROUND OF THE INVENTION

Field of the Invention (Technical Field):

The present invention relates to medical tourniquets, specifically to a medical tourniquet that is easy to use reliably and quickly.

Background Art:

Tourniquets are used in medical emergencies to arrest life-threatening arterial or venous bleeding. A tourniquet is applied around an arm or leg, or other body extremity, to constrict the blood vessels between the patient's heart and the bleeding wound. Tourniquets must be used with care and knowledge, as stopping the flow of blood to the wound also stops the flow of blood to the entire extremity below the tourniquet; prolonged blood deprivation from improperly extended or regulated tourniquet use can lead to tissue death in the affected limb.

Because misuse of a tourniquet can be unnecessarily hazardous, properly applied direct pressure to the wound may be preferred to tourniquet use. Nevertheless, recent studies have confirmed the utility of tourniquets as the first line of medical intervention in extreme trauma situations. While proper training in proper tourniquet use remains essential, the tourniquet is receiving renewed interest as an effective tool in first-aid and paramedical treatment of severe bleeding.

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Conventional tourniquets commonly in use have remained essentially unchanged for decades. Existing tourniquets typically consist of a single strap, possibly with a buckle for securing it in an adjustable loop, and a rigid rod. The looped strap is wrapped around the affected limb, and the rod is inserted between the limb and strap and then rotated, in a plane about parallel to the surface of the limb, in an "over-under" manner about the strap to twist the strap. As the strap is twisted with the rod, the effective length of the looped strap is shortened to constrict the limb. When the tourniquet is adequately tightened, the user must then temporarily secure the rod in position to maintain the twist in the strap. A variety of methods have been devised or improvised to so secure the rod, such as tucking an end of the rod back under the strap, or tying an end of the rod to the strap with a separate ribbon or cord. Known methods for securing the rod to maintain the strap constriction are generally unreliable and time consuming.

Tourniquets are commonly included, for example, in military field medical kits. The tourniquet in the U.S. military's current inventory is inadequate in its design. The tourniquet in the U.S. military inventory has remained essentially unchanged for about 50 years. When first designed, the military tourniquet was intended as a tool of last resort. Since then however, professional opinions about the utility and advantages of tourniquet use in severe cases have changed. The desirability of employing a tourniquet has increased, without any improvement to the tourniquet tools themselves. The buckle used to secure the strap on military tourniquets operates on a spring action. If the buckle is accidentally bumped, it may spring loose. Since these buckles are unreliable and unstable, they may jeopardize a briefly unattended patient's life. Further, the strap itself demands the use of brute strength to achieve adequate constriction to properly restrict blood flow. Many persons using current tourniquet models are unable to tighten the tourniquet enough to occlude both arterial blood flow and venous return, creating a medical hazard.

As a result, a strong need remains for a tourniquet that is easy to use rapidly in emergency situations, including under conditions of darkness, and yet is reliably secured after tightening in order to prevent accidental release.

SUMMARY OF THE INVENTION (DISCLOSURE OF THE INVENTION)

5 The present invention relates to a tourniquet that can be applied to an affected limb rapidly and tightly enough to restrict arterial and venous blood flow. The present tourniquet apparatus is made of materials impervious to environmental conditions. The invention is simply applied, resistant to dry rot, and can be used in all weather and field conditions. The apparatus of the present invention can be applied more tightly than current tourniquets, especially those used by the military. The apparatus is simple, making it very easy to use by virtually anyone. Once tightened, the tourniquet is very secure, due to incorporation of a cam buckle to secure the strap, and special loops and pockets for securing the tightening rod. The invention finds particular utility in military applications, as well as use by, for example, outdoorsmen (e.g., hunters and fishermen), firemen, emergency medical technicians, veterinarians, and park and forest rangers.

10 A primary object of the present invention is to provide a tourniquet apparatus that is simple and easy to use.

15 A primary advantage of the present invention is that once tightened, the tourniquet apparatus reliably remains in proper tightened position, even when inadvertently bumped or jostled by patient movement.

20 Other objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated into and form a part of the specification, illustrate several embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating a preferred embodiment of the invention and are not to be construed as limiting the invention. In the drawings:

Fig. 1 is a perspective view of a preferred embodiment of the tourniquet according to the present invention;

Fig. 2 is a perspective view of the apparatus of the invention depicted in Fig.1, showing one end of the tightening rod secured in position in a retainer loop portion of a loop-pocket assembly slidably disposed upon the strap;

Fig. 3 is a perspective view of the apparatus depicted in Fig.2, showing both ends of the tightening rod secured in position within retainer pockets of loop-pocket assemblies slidably disposed upon the strap;

Fig. 4A is an end view of the retainer loop-pocket assembly of the invention;

Fig. 4B is a bottom view of the loop-pocket assembly depicted in Fig. 4A;

Fig. 4C is a top view of the assembly depicted in Fig. 4B;

Fig. 4D is a perspective side view of the assembly depicted in Fig. 4C; and

Fig. 5 is a diagram of an alternative embodiment of the tourniquet apparatus of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS  
(BEST MODES FOR CARRYING OUT THE INVENTION)

The tourniquet apparatus of the invention is simple in construct and use, but marks a significant improvement over existing tourniquets commonly in use.

Reference is made to Fig. 1. Tourniquet **10** of the invention features five principle components: strap **12**, cam buckle **16**, tightening rod **20**, and two essentially identical loop-pocket assemblies **24**, **28**. Strap **12** performs the function of conventional tourniquets, as it is looped around the patient's affected limb or extremity and tightened to constrict the flow of blood. Strap **12** is preferably made from generally non-stretchable nylon webbing strap material, such as 1-inch woven nylon strap. Strap **12** has an overall length, before being looped and sewn according to the invention, of about preferably 28 inches to about 36 inches, although it is immediately realized that the strap can be manufactured to any suitable length, including great lengths permitting the tourniquet to be used about the thigh of larger adults (e.g., a length preferably between approximately 36 inches and approximately 40 inches) or relatively small versions for use, for example, on children or around an adult wrist (e.g., a length preferably between approximately 6 inches and approximately 28 inches).

The ends of strap **12** are finished for durability by being doubled back and sewn into reinforced end portions **34**, **35**. Fig. 1 depicts strap **12** disposed into a looped configuration to define opening **32** through which the affected limb is passed prior to tightening of tourniquet **10**. Strap **12** is connected to cam-type buckle **16** which is preferably manufactured from high-impact lightweight plastic, however, other suitable materials, such as metal alloys, may be utilized. One end **35** of strap **12** is looped through the rung of buckle **16** and is then doubled back against the body of the strap and preferably permanently sewn together at connection point **36**. Opposing end **34** of strap **12** passes through the cam portion of buckle **16** and is adjustably movable therethrough for adjustment of the size of opening **32** defined by strap **12** to loosen or tighten tourniquet **10**.

Buckle **16**, which is preferably a typical "off-the-shelf" type buckle presents the advantage of allowing tourniquet **10** to be used quickly and easily, even in poor lighting conditions. The buckle is preferably a cam-type buckle, but other suitable buckles may be used. Buckle handle tab **39** is movable between a closed position and an open position. In the closed position, strap **12** is securely clamped within buckle **16** so that the length of strap **12** between free end **34** and buckle **10** is fixed. In the open position, buckle **16** is free to slidably move along strap **12** allowing the circumference of the looped tourniquet to be adjustable, and as a result, allowing the size of opening **32** to be adjustable. When tourniquet **10** is in use around a patient's limb, the user pops buckle **16** into the open position and then slides buckle **16** along strap **12** cinching strap **12** to the appropriate tightness around the limb (*i.e.*, adjusting the size of opening **32** to the proper dimension). With looped strap **12** appropriately tightened, the user can then depress buckle handle tab **39** to actuate the buckle cam to securely clamp buckle **16** on strap **12** and thus reliably and securely fix tourniquet **10** in place.

Disposed upon strap **12** is rigid cylindrical tightening rod **20**. Tightening rod **20** preferably is crafted from black Delrin® composite, about 4 to about 5 inches long and about 1/2-inch in diameter. Alternatively, it may be an aluminum cylinder; however, other suitable materials (*e.g.*, wood, plastic, rubber, and other metal alloys) and dimensions (*e.g.*, smaller or larger) for the rod may be utilized, including rods with grippers such as rubber grips disposed on the rod or indentations for receipt of fingers. Advantageously, tightening rod **20** is preferably slidably mounted upon strap **12** (depicted in Fig. 1), by passing the strap through a correspondingly sized and medially located aperture **21** through the rod. The aperture **21** may be, for example, about one inch longitudinal dimension and about 1/8 inch transverse, with ends finished with a 1/8 inch diameter corner. By this means, rod **20** is fixably located upon strap **12**, and is preferably never separated therefrom. However, other embodiments utilizing a removable rod that is temporarily fixable along the strap are within the scope of the invention. After being passed through aperture **21** and the cam portion of buckle **16** during initial assembly of the tourniquet, free end **34** of strap **12** may be doubled over and sewn (or otherwise fixably secured), so as to comprise a "stopper" of sufficient thickness to prevent free end **34** from passing back through either buckle **16** or aperture **21** in

rod **20**. Entire tourniquet **10**, including loop-pocket assemblies **24, 28**, can be secured as a single unit, eliminating the possibility of lost parts (if secured in such a manner). As rod **20** is slidably movable along the length of looped strap **12**, it can readily be positioned by the user for use. However, the invention is advantageous in that if the user happens to drop the rod in the hurry of the moment, it will not fall to the ground and become lost or contaminated, but instead remains upon strap **12**. Once positioned, rod **20** is rotated around itself (*i.e.*, the ends of the rod are rotated around the rod's center point) to twist strap **12** thereby tightening it to constrict blood flow in the affected limb.

Key components of the invention are loop-pocket assemblies **24, 28**. Loop-pocket assemblies **24, 28**, are essentially identical. The preferred embodiment of the invention features a pair of loop-pocket assemblies, although a workable embodiment may feature a single loop-pocket assembly. Each assembly **24, 28** is preferably manufactured from 1-inch non-stretchable woven nylon web strapping. Referring collectively to Figs. 1 and 4A-D, each assembly **24, 28** includes looped portion **42**, preferably comprised of a section of webbing configured to define a loop having approximately a 1-inch diameter. Loop portion **42** is sewn to, or otherwise permanently looped through, layers of stem **43** which is preferably comprised of three layers of webbing sewn together. The sections of nylon webbing comprising stem **43** extend outwardly to define the pocket portion, which has two pockets **45, 46** defined therein.

Referencing Figs. 4A-D, pockets **45, 46** are preferably defined by three layers of webbing which are aligned in a parallel manner with one middle section **50** sandwiched between two exterior sections **51, 51'**. (A single length of webbing strap may be twice doubled back upon itself to define the three layers or sections.) Two layers (one outside section **51** and middle section **50**) are sewn, permanently glued, or otherwise suitably fixed along their aligned "top" edges to define first downwardly-opening pocket **46**. The other sections (*i.e.*, the other outside section and the middle section) are sewn or glued together along their aligned "bottom" edges, thereby defining second upwardly-opening pocket **45**. Thus middle section **50** acts as the common wall separating two pockets **45, 46**. As best depicted

perhaps, in Figs. 4B-D, pockets **45**, **46** preferably open in opposite directions, thereby enhancing the versatility of the invention. Fig. 4D depicts a side view of assembly **24**, showing two exterior sections or layers **51**, **51'**, separated by middle section **50**, thereby defining first pocket **46** and second pocket **45**.

Fig. 1 also depicts the preferred embodiment of the present invention whereby loop-pocket assemblies **24**, **28** are slidably disposed upon strap **12** by simply passing strap **12** through loop portion **42** of each respective loop-pocket assembly **24**, **28**. Thus, the positions of loop-pocket assemblies **24**, **28** upon strap **12** are adjustably slidable by simply sliding the assemblies **24**, **28** along strap **12**.

A principal advantage of the invention is the use of loop-pocket assemblies **24**, **28** to secure tightening rod **20** in position after it is used to tighten strap **12**. Attention is invited to Fig. 2, where in a preferred embodiment after rod **20** has been used to twist strap **12** to the proper tightness about the patient's limb, rod **20** is roughly parallel to tightened strap **12**. (For the sake of clarity, neither the patient's limb nor the actual twisting of the strap are shown in Fig. 2; however, the nature of strap twisting and the disposition of the limb through opening **32** in the looped strap are readily understood and envisioned by one of ordinary skill in the art.) End of rod **20** may then be inserted into looped portion **42** of loop-pocket assembly **24**. Rod **20** thus is held and maintained in position to secure strap **12** in the appropriately twisted condition thereby sustaining constriction upon the treated limb. Fig. 2 shows only one end of the rod held within loop **42** of one loop-pocket assembly **24**. It is immediately apparent, however, that the other end of rod **20** could also be inserted into other loop portion **42** of other loop-pocket assembly **28**. Notably, each of loop-pocket assemblies **24**, **28** can be movably positioned along strap **12** in order to place loop portions **42** of each of assemblies **24**, **28** in location to receive the corresponding ends of tightening rod **20**. With both ends of rod **20** inserted into loop portions **42** of loop-pocket assemblies **24**, **28**, rod **20** is reliably fixed in position to hold tourniquet **10** in the twisted, constricting configuration.



In other situations, rod **20** has been used to twist strap **12** to the proper tightness about the patient's limb, and rod **20** is in a resultant position roughly perpendicular to tightened strap **12**. Reference is made to Fig. 3, where again for the sake of clarity, neither the patient's limb nor the actual twisting of the strap are depicted. End of rod **20** may be inserted into pocket **46** of assembly **24**. Rod **20** is fixed in position to secure strap **12** in the appropriately twisted configuration in order to sustain the appropriate constriction upon the treated limb. Fig. 2 shows that the other end of rod **20** can be held similarly within pocket **45** of loop-pocket assembly **28**. It is immediately apparent, however, that the invention may function adequately to hold rod **20** fixed and prevent "untwisting," by inserting one end of rod **20** in only one loop portion **42**. Notably, each of loop-pocket assemblies **24**, **28** can be movably positioned along strap **12** in order to place either of pockets **45**, **46** in location to receive corresponding ends of tightening rod **20**. With both ends of rod **20** inserted into either pocket **45**, **46** rod **20** is fixed in position to hold tourniquet **10** in the appropriate twisted, constricting configuration, even though rod **20** may be perpendicularly oriented in relation to strap **12**.

Fig. 5 illustrates an alternative embodiment of the invention having single loop assembly **60** that comprises secondary looped finger pull **62** in lieu of any pockets.

Referring to all figures, the method of use preferably involves removing tourniquet **10** from (preferably sterile) storage and disposing the affected limb through opening **32** defined by looped strap **12**. Tourniquet **10** is placed in immediate relation "above" the bleeding wound. Tightening rod **20** and loop-pocket assemblies **24**, **28** are predisposed upon strap **12**, and "free" end **34** of the strap is already threaded through buckle **26**, therefore a user has no need to rummage about for tourniquet components losing valuable time. Rather, the tourniquet can be placed rapidly in its proper position, even in unfavorable conditions such as darkness.

With the loop of the tourniquet properly placed upon the affected limb, the user then releases buckle **16** to its "open" position by lifting buckle handle tab **39**. Buckle **16** is slipped along strap **12**, and free end **34** of strap **10** is pulled, pushing buckle **16** toward the patient's limbs thereby reducing the circumference of the looped portion of strap **12**. This tightens strap **12** around the limb. When a preferably trained professional user has determined that strap **12** is adequately tightened by means of sliding buckle **16**, the user then forcibly depresses tab **39** to actuate the cam in buckle **16** in a fixed position upon strap **20**. The user then accomplishes the actual life-saving constriction of tourniquet **10** by rotating handle-like rod **20** to twist and further tighten strap **12**. As strap **12** is twisted about itself, the diameter of opening **32** in the looped portion of strap **12** is further reduced. The twisting action is continued by the user until, in the user's trained opinion, the tourniquet is sufficiently tightened to completely occlude any bleeding. At this point, rod **20** may be approximately perpendicular to strap **12**, in which case the user slides loop-pocket assemblies **24**, **28** along strap **12** into position on either side of rod **20**. The user then lifts either or both pockets **45**, **46** over respective ends of rod **20**. The ends are tucked securely into pockets **45**, **46**. Loop-pocket assemblies **24**, **28** hold rod **20** in place, preventing its natural counter-rotation and "unwinding" when not fixed in place.

Alternatively, if the proper twisting of strap **12** results in a disposition of rod **20** approximately parallel to the longitude of strap **12**, the user slides either or both loop-pocket assemblies **24**, **28** to positions adjacent the ends of rod **20**, and the ends of rod **20** are tucked into loop portions **42** of assemblies **24**, **28**. Rod **20** is prevented from "unwinding" as a result. Advantageously, no matter how rod **20** must be positioned to achieve the proper tightening of the tourniquet, loop-pocket assemblies **24**, **28** may be used to secure rod **20** against accidental or inadvertent release. Tourniquet **10** therefore remains fixed until deliberately released.

Because each of loop-pocket assemblies **24, 28** has a pair of oppositely-facing pockets **45, 46**, the apparatus readily accommodates either clock-wise or counter-clockwise rotation of the rod **20**, and versatile placement of either of the pockets over the respective ends of the rod to hold it in place against unwinding, pending the patent's transportation to a critical care facility.

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Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover all such modifications and equivalents.

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FOR THE PATENT OFFICE